Young, O. P. and G. B. Edwards. 1990. Spiders in United States field crops and their potential effect on crop pests. J. Arachnol., 18:1-27.

SPIDERS IN UNITED STATES FIELD CROPS AND THEIR POTENTIAL EFFECT ON CROP PESTS

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ABSTRACT

An analysis of 29 faunal surveys of spiders found in nine field crops in the United States indicates the presence of 614 species in 192 genera and 26 families. These species represent 19% of the ca. 3311 species occurring in North America. Five families included 61% of the species reported in field crops: Salticidae (89 spp.), Linyphiidae (78), Araneidae (77), Theridiidae (64), and Lycosidae (62). Considerably more species have been observed in cotton (308 spp.), soybean (262), and alfalfa (233) than in guar (52), rice (75), and grain sorghum (88). Intermediate numbers of species have been observed in peanuts (131), corn (136), and sugarcane (137). The North American spider fauna is estimated at the species level to be 59% web-spinners and 41% wanderers, while those reported from field crops are estimated to be 44% web-spinners and 56% wanderers. These differences may be attributable to guild characteristics associated with dispersal and ability to survive in disturbed habitats. The 42 most frequently occurring spider species were considered in detail and demonstrated that the active wandering guild comprised the largest portion (45%) of this group. Orb-web (21%), sheet-web (19%), ambush-wander (10%), and web-matrix (5%) spiders represented other guilds. The most frequently occurring species in field crops were *Oxyopes salticus* Hentz (Oxyopidae), ***Phidippus audax*** (Hentz) (Salticidae), and *Tetragnatha laboriosa* Hentz (Araneidae). These three species are prime candidates for augmentation and conservation in field crops or in adjacent habitats as part of a strategy to increase predation on crop pests.

INTRODUCTION

As recently as 1984, a review of spiders as biocontrol agents was able to lament the current failure to consider the potential of spiders in insect suppression programs (Riechert and Lockley 1984). This same review pointed out that generalist predators such as spiders can in certain situations limit exponential increases in insect populations in both natural and agricultural systems. A more recent review of an abundant spider in agroecosystems, *Oxyopes salticus* Hentz, indicated the considerable potential of this species for suppressing insect pest

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populations in agroecosystems (Young and Lockley 1985). These reviews and others increasingly point to the importance of spiders as part of a strategy of Integrated Pest Management.

Any investigator, however, who wishes to examine the spider fauna in a field crop faces an immediate problem. The identification of species ia a tortuous process for the novice, and may be close to impossible for many taxonomic groups and for immature spiders. There is no single reference available to identify the approximately 3311 species in North America, and only one regional work (New England) attempts to provide identification aids for all resident species (Kaston 1981). The approximately 470 genera of spiders in North America can be identified with the aid of Roth (1985). The most commonly used North American identification manual for novices considers only 223 genera and, though presenting generalized descriptions of many species, contains no species-level keys (Kaston 1978). Thus the identification of spiders must be performed by (1) use of generic revisions of a highly technical nature, many of which are outdated, (2) comparison with reference collections, most of which are at major urban museums and relatively inaccessible to the agricultural researcher, and (3) consultation with an expert in spider taxonomy, the number of which may be less than 20 in the United States and Canada. Several of these experts are retired or nearly so; all are overworked and reluctant to process large lots of specimens. These factors alone may have discouraged past research in the spider fauna in agroecosystems; they continue to be impediments to present and future research. In this regard it is noteworthy that two agricultural research groups in the United States that actively publish surveys of field-crop spiders are fortunate to have in-house taxonomic expertise (i.e., Dean and Eger 1986, Lockley and Young 1986).

We have failed to detect significant movement in the last 10 years toward implementation of any pest suppression strategy in the United States that specifically includes spiders as part of the suppression strategy, though the TEXCIM model for cotton fleahopper-*Heliothis* suppression may be a recent exception (Hartstack and Sterling 1988). One possible reason for the slow progress may be due to minimal knowledge concerning the species composition, densities, and distribution of spiders in field crops. In an attempt to facilitate the use of spiders in insect suppression strategies, we here summarize 29 faunal surveys of spiders found in field crops of the United States. We further evaluate the quality of the data base, analyze and interpret the data, and suggest directions for future research.

MATERIALS AND METHODS

The entomological-araneological literature was searched for surveys of spiders in North American field crops. We restricted the database to surveys that included the following information: (1) majority of spiders identified to species, (2) degree of sampling effort specified, (3) method and diel period of sampling specified, and (4) degree of taxonomic assistance indicated. Information from items 2-4 was coded (Table 1) and placed as an annotation after each survey citation (Appendix 2). This format provided criteria to evaluate survey quality.

The nomenclatural problems associated with such a compilation from 29 different sources were particularly difficult to overcome. Many surveys contained

Table 1.—Summary of sampling methodologies utilized in 29 field-crop surveys of spiders. Values represent descriptive statistics or number in each category.

A. Number of years of sampling	
Range	1-10
Mean	2.7
Mode	1, 3
B. Maximum number of months sampled within a year	
Range	3-12
Mean	6.2
Mode	4
Not indicated	4
C. Diel sampling period	
1. Dirunal	29
2. Nocturnal	6
D. Maximum no. fields sampled/month	
Range	1-40
Mean	8.8
Mode	3
Below mean	18
Not indicated	3
E. Methods of sampling	
1. Sweep	20
2. Vacuum	11
3. Pitfall	18
4. Hand	16
5. Berlese	3
6. Dip net	1
7. Shake-cloth	7
F. Acknowledgment of taxonomic assistance	
1. Yes	17
2. No	12

species names that: (1) recently had been split into several species, or combined with another species name, (2) were no longer valid, (3) belonged in a different family or genus, or (4) were probable misidentifications. The resultant species list is our best estimate of the correct names and placement of species. We followed Roth (1985) as the most current source of information on placement and acceptability of familial and generic names.

RESULTS AND DISCUSSION

Limitations of the data.—Most surveys of arthropods in field crops usually focus on a particular pest or group of pests (e.g., Scott et al. 1983a). When non-pest arthropods are collected they are typically recorded as "beneficials", or the most common ones may be determined to species (e.g., Scott et al. 1983b; Parencia et al. 1980). This usually is not the case for spiders, which unfortunately are often lumped together into one group (e.g., Smith et al. 1976), or at best subdivided into functional groups (e.g., Lockley et al. 1979). Such generalized categorizations may be due to the identification problems previously mentioned and to the fact that arachnologists typically have not conducted faunal surveys in field crops, preferring more undisturbed areas where spider populations are usually larger and more diverse. The net result is a paucity of information about spiders associated with field crops. Nevertheless, we obtained copies of 29 surveys of field-crop spiders that met our criteria for inclusion. Only 12 of these surveys were published in refereed journals; the remainder appeared in state scientific societal or agricultural experiment station publications (12), or as unpublished theses and dissertations (5).

Assessing the quality of the 29 manuscripts utilized in one analysis was difficult, because established criteria for determination of quality were unavailable. Six parameters were chosen that we believe should be included when a faunal survey is published: (1) number of years of sampling, (2) maximum number of months sampled within a year, (3) diel sampling period, (4) maximum number of fields sampled per month, (5) method of sampling, and (6) acknowledgement of taxonomic assistance. We then tabulated the manuscripts within categories of each parameter (Table 1).

One survey was conducted over a ten-year period, another over six, whereas 22 surveys lasted three years or less. Surveys <3 years are not likely to demonstrate long-term trends, but should be sufficient to detect most species in an area. Although several surveys were conducted over an entire 12-month period each year, a majority (17) lasted for only 3-6 months. In some cases this short time represented the life-span of the crop, though usually survey duration coincided with the period of crop maturity or with peak arthropod abundance. The number of different sites (fields) sampled each month ranged from 1 to 40; half the surveys included four or fewer sample sites. Small sample sizes may not detect variability within and among sites and may distort the relationship of single-site abnormalities to other more typical sites.

Considerable variability was apparent in the importance that investigators placed on sampling effort and the methods employed; some surveys even failed to mention sampling effort. Most surveys utilized a variety of collection methods, though five surveys used only one method. When methods to obtain both foliage- and ground-dwelling spiders were employed, total number of species obtained were higher than in single-strata surveys. Only six collection programs included methods that specifically obtained nocturnal specimens, though 18 programs included a method (pitfall) that collected ground-dwelling forms both day and night.

Twelve surveys failed to acknowledge taxonomic assistance from specialists. Given the aforementioned difficulties in spider identification, the likelihood that a non-specialist could correctly identify all specimens obtained in a faunal survey is indeed remote. Finally, the variability in methodologies among the 29 surveys is probably less than that of faunistic surveys of spiders in nonagricultural habitats (see review in Young et al., 1989). We conclude that a hypothetical "high quality" survey would employ several collection methods to sample both foliage- and ground-dwelling spiders, day and night, 12 months of the year, for 3-5 years, and at ten or more locations.

Spider fauna of nine agroecosystems.—Faunal surveys were obtained for nine crop systems in the United States, though not all systems were equally surveyed (Appendix 1). Grain sorghum, guar, and peanuts were surveyed only once, whereas multiple surveys were obtained for rice (2), sugarcane (2), corn (2), alfalfa (4), cotton (7), and soybean (9). Species richness of spiders among the nine crop systems can be grouped into three levels. Cotton contained the most species ($\leq$ 308), with soybean ($\leq$ 262) and alfalfa ($\leq$ 233) in the same high diversity group. Guar ($\leq$ 52), rice ($\leq$ 75), and grain sorghum ($\leq$ 88) comprised the group with the lowest number of species. An intermediate group was represented by peanuts ($\leq$ 131), corn ($\leq$ 136), and sugarcane ($\leq$ 137). The wide disparity in numbers of spider species that occur in these crop systems can be attributed to several factors. Those crops surveyed most frequently had the most species, which suggests sampling bias. A more likely explanation, however, involves the structural complexity of plants. The nine crop plants can be separated into two groups based on growth form: (1) multiple-branching dicotyledonous forms include alfalfa, soybean, cotton, peanuts, and guar; and (2) simple-branching monocotyledonous forms include rice, grain sorghum, sugarcane, and corn. Given the known positive correlation between plant structural complexity and numbers of associated spiders (Greenstone 1984; Hatley and MacMahon 1980; Uetz 1976), it is not surprising that cotton, for instance, supports many more spider species than rice. Two apparent exceptions to this trend, guar and peanut, may be due to minimal sampling effort.

Considering all field-crop systems as a whole, the spider community is dominated by only a few of the 48 families that occur in all North American habitats. Species of 26 families occur in field crops; 5 families contained 61% of the total field-crop species—Salticidae (89 spp.), Linyphiidae (78), Araneidae (77), Theridiidae (64), Lycosidae (62). Conversely, 6 families were represented by only 1 species. Several genera were represented by large numbers of species in field crops—*Theridion* (19 spp.), *Lycosa* (17), *Xysticus* (16), *Dictyna* (15), *Phidippus* (14). However, of the 192 genera recorded from field crops, 105 were represented by only 1 species (Table 2).

Relation of crop fauna to North American fauna.—Millions of acres annually in North America are occupied by various crop systems. About 22% of the land in the United States is devoted to cropland, with another 8% covered by roads, parking lots, houses, factories, and other structures (Anon. 1987). The remaining 70% is comprised of pastures, rangeland, forests, and margins; these are the sources of spider immigrants to field crops. About 3311 species of spiders in 470 genera and 48 families are found in North America (Roth 1985) (Table 2). Fifty-four percent of the families, 41% of the genera, and 19% of the species also occur in field crops. At least one exhaustive field survey of the spiders of an entire county indicates that these values for North America may be representative of much smaller areas, as 19% of the species collected in Washington Co., Mississippi, also occurred in field crops (Young et al. 1989).

The ten largest families of spiders in North America comprise 84% of the total number of species. Some of these families, however, are poorly represented in field crops (Table 2). Only 7% of the 252 agelenid species are associated with field crops; likewise 9% of the 845 linyphiid species and 11% of the 159 dictynid species occur in field crops. Conversely, several families are well represented in field crops, e.g., 40% of the 192 araneid species, 31% of the 288 salticid species, and 31% of the 128 thomisid species. Several factors may account for these considerable differences between families. The most difficult spiders to identify are the small-sized species of Linyphiidae. Some faunal surveys avoid this problem by assigning linyphiids to one undifferentiated category, i.e., Erigoninae. Thus, many more species of Linyphiidae likely occur in field crops than are recognized or reported, particularly given their strong aerial dispersal characteristics (Greenstone et al. 1987). Conversely, three of the taxonomically better known spider families - Araneidae, Thomisidae, and Salticidae - are well represented in field crops and known to be strong aerial or ground dispersers (Greenstone et al. 1987; Young, unpubl. data).

One might expect a larger percentage of the total North American spider fauna to occur in field crops. That such apparently is not so suggests that a selection process is occurring, where only certain spider characteristics lead to increased likelihood of occurrence in field crops. These characteristics probably are associated with dispersal and subsequent survival in a highly disturbed and sometimes noxious environment.

Prey-capturing guilds.—Functionally, spider families can be categorized on the basis of prey capture method, e.g., web-spinning or wandering species (Table 2).

Table 2.—Proportions of genera and species of North American spiders that occur in field crops. a = genera and species data from Roth (1985), b = data from Gertsch (1979), Comstock (1940). Percentages in parentheses.

	Genera			Species			
Araneomorphae Family	N. A.[a]	Field crops	(%)	N. A.[a]	Field crops	(%)	Prey-capture technique[b]
Agelenidae	25	6	(24)	252	17	(6.7)	Web-Sheet
Amaurobiidae	8	1	(12.5)	82	1	(1.2)	Web-Sheet
Anapidae	1	0		1	0		Web-Orb
Anyphaenidae	5	5	(100)	37	13	(35.1)	Wand-Active
Aphantochilidae	1	0		1	0		Wand-Ambush
Araneidae	42	30	(71.4)	192	77	(40.1)	Web-Orb
Caponiidae	2	0		3	0		Wand-Active
Clubionidae	20	11	(55)	193	47	(24.4)	Wand-Active
Ctenidae	3	0		5	0		Wand-Active
Desidae	1	0		1	0		Web-Sheet
Dictynidae	9	3	(33.3)	159	18	(11.3)	Web-Sheet
Diguetidae	1	0		6	0		Web-Matrix
Dinopidae	1	0		1	0		Web-Orb
Dysderidae	3	2	(66.7)	7	2	(28.6)	Wand-Active
Filistatidae	3	1	(33.3)	13	1	(7.6)	Web-Sheet
Gnaphosidae	24	12	(50)	248	38	(15.3)	Wand-Active
Hahniidae	3	1	(33.3)	19	4	(21.1)	Web-Sheet
Hersiliidae	1	0		2	0		Wand-Active
Homalonychidae	1	0		2	0		Want-Active
Hypochilidae	1	0		4	0		Web-Matrix
Leptonetidae	2	0		34	0		Web-Matrix
Linyphiidae	152	32	(21.1)	845	78	(9.2)	Web-Sheet
Loxoscelidae	1	0		13	0		Web-Sheet
Lycosidae	16	10	(62.5)	234	62	(26.5)	Wand-Active
Mimetidae	2	2	(100)	13	7	(53.8)	Wand-Ambush
Mysmenidae	3	1	(33.3)	6	1	(16.7)	Web-Orb
Nesticidae	3	1	(33.3)	31	1	(3.2)	Web-Matrix
Ochyroceratidae	1	0		1	0		Web-Sheet
Oecobiidae	2	1	(50)	7	2	(28.6)	Web-Sheet
Oonopidae	8	0		24	0		Wand-Active
Oxyopidae	3	3	(100)	20	6	(30)	Wand-Active
Philodromidae	5	5	(100)	95	28	(29.5)	Wand-Active
Pholcidae	10	2	(2)	31	3	(9.7)	Web-Matrix
Pisauridae	4	2	(50)	14	9	(64.3)	Wand-Active
Plectreuridae	2	0		15	0		Wand-Active
Salticidae	45	33	(73.3)	288	89	(30.9)	Wand-Active
Scytodidae	1	0		9	0		Wand-Active
Selenopidae	1	0		5	0		Wand-Ambush
Sparassidae	3	0		8	0		Wand-Ambush
Symphytognathidae	1	0		1	0		Web-Orb
Telemidae	1	0		3	0		Web-Sheet
Tengellidae	1	0		5	0		Web-Sheet
Theridiidae	27	17	(63)	231	64	(27.7)	Web-Matrix
Theridiosomatidae	1	1		2	1		Web-Orb
Thomisidae	10	8	(80)	128	40	(31.3)	Wand-Ambush
Uloboridae	7	2	(28.6)	15	3	(20)	Web-Orb
Zodariidae	2	0		4	0		Wand-Active
Zoridae	1	1	(100)	1	1	(100)	Wand-Ambush
Totals	470	192	(40.9)	3311	614	(18.5)	

Table 3.—Comparison of two prey-capturing guilds, web-spinning and wandering, for North America and for field crops. Each family assigned to a guild based on data from Roth (1985), Kaston (1981), Gertsch (1979), and Comstock (1940). Percentages in parentheses.

	Web-spinning	(%)	Wandering	(%)
N.A. fauna				
Families	25	(52.1)	23	(47.9)
Genera	307	(65.3)	163	(34.7)
Species	1955	(59)	1356	(41)
Field crops				
Families	13	(52)	12	(48)
Genera	98	(51)	94	(49)
Species	271	(44.1)	343	(55.9)

The North American spider fauna is estimated at the species level to be 59% web-spinners and 41% wanderers (Table 3). The spider fauna of field crops, however, is estimated to be 44% web-spinners and 56% wanderers. Such disparity between the North American fauna and the field-crop fauna may be attributable to several factors, which include dispersal (colonization) differences between guilds and survival differences among disturbed (agricultural) habitats.

Dispersal differences between guilds.—Crop fields are assumed to be composed of spider populations that have emigrated from adjacent habitats or are year-round residents (Luczak 1979). Perennial crops such as alfalfa are more likely to have over-wintering populations of spiders than annual crops such as wheat. However, studies in England surprisingly have demonstrated that spider diversity and density on enclosed land freshly plowed and cultivated in the autumn were maintained until early spring as compared to similarly-treated land where spiders were free to emigrate (Duffey 1978). Unfortunately, the ability of spiders to survive autumnal crop harvest and subsequent soil disturbance has not been investigated in the United States. Thus we are left with the assumption that spiders immigrate each year from adjacent habitats into annual field crops, with minimal overwintering in the crop field. Such immigration occurs aerially by floating on silk threads (ballooning), or by silk-thread bridges between plants, or by ambulatory movements on the ground (Gertsch 1979). Most of the spider individuals that undergo aerial movement in field crops are araneids and linyphiids, both families of web-spinners (Greenstone et al. 1987; Dean and Sterling 1985). Wanderers, e.g., Salticidae and Lycosidae, comprised less than 9% of the aeronauts in some investigations (Plagens 1986; Salmon and Horner 1977). Crop fields and adjacent disturbed habitats may generate proportionately more aerial dispersers than other habitats, because species that occupy these "unstable" habitats have greater aeronautic dispersal powers (Greenstone 1982; Meijer 1977).

Survival differences between guilds.—Only those spider species with good dispersal characteristics are likely to appear in a field crop. Their continued presence in the crop, however, is due to other characteristics, such as their ability to avoid predation, tolerate the typically hot and dry environment, adapt to the particular plant structure and spatial pattern, and find food. In general, web-spinners and wanderers exhibit differences in these abilities. Wandering spiders contain few examples of feeding specialists, with most species capable of capturing a wide diversity of prey types and sizes (Nentwig 1986). One of the most abundant spiders in field crops is a wanderer, *Oxyopes salticus*, which consumes at least 34 species of insects in 21 families and nine orders (Young and Lockley 1985). Web-spinners, however, exhibit considerable specialization on prey types and sizes (Nentwig 1985). This suggests that wandering spiders may be more likely to find suitable food than web-spinners in a field crop.

Habitat characteristics that are particularly important to web-spinners are plant structure and spacing. Increased availability of substrate for web attachment is usually associated with increased spider density (Rypstra 1983). Many of the larger orb-weavers have specific habitat preferences for particular heights above the ground and large distances between plants (Enders 1974). Such conditions may occur in field crops for only short periods of time or not at all. Sheet-web and tangle-web weavers also have substrate requirements that infrequently are available in field crops (Rypstra 1983). The movement through a crop field of farming equipment associated with cultivation and chemical applications no doubt damages a considerable proportion of the resident spider webs, but probably has less effect on the wandering spiders. Factors associated with the degree of food specialization, the structure of the habitat, and the differential impact of disturbance may be sufficient to explain the relatively lower numbers of web-spinning species in field crops.

Characteristics of the most frequently occurring spiders in field crops.—The 29 faunal surveys considered herein represent a geographic range from New York to Florida to California and a plant-structural range from rice to soybean. Several spider species occur over a wide geographic range and in a variety of crops. Forty-two species (Table 4) are widely distributed among the crop systems investigated thus far and probably represent the most abundant species found in field crops. At least 1/3 of the 42 species average less than 4 mm in body length. Such small spiders probably prey on the smaller pests such as thrips, aphids, and immatures of Heteroptera and Lepidoptera. The dispersal of the eight small-sized linyphiid species (Table 4) is more affected by the unpredictability of air currents than is that of the larger species (Greenstone et al. 1987). Their capture in field crops thus may indicate only recent accidental arrival and not necessarily successful predatory activity. The largest guilds in this assemblage of 42 species are the active wanderers (19 species) and the orb-web spiders (9 spp.), which suggests that active wandering may be the most successful hunting strategy employed by spiders in field crops. Three species—*Tetragnatha laboriosa* Hentz, *Oxyopes salticus*, *Phidippus audax* (Hentz)—have been found in all nine crop systems, usually were the most abundant predators in those crops, and are among the most abundant spiders in North America (Kaston 1978). *Tetragnatha laboriosa* is a small orb-weaver that may leave its web to disperse or search for food and is frequently captured in ground pitfall traps (Culin and Yeargan 1983). Other members of the genus *Tetragnatha* actively seek prey away from the web in ways similar to wandering spiders (Horn 1969). *Oxyopes salticus* is an active wanderer more tolerant of hot and dry crop situations than some other common predators of the southeastern United States (Mack et al. 1988), and was the numerically dominant predator in several crop systems (Young and Lockley 1985). *Phidippus audax* is an active wanderer that is large (body length 8-15 mm), hunts on foliage, often is locally abundant, consumes a wide range of prey sizes, and occurs in many habitats (Roach 1987; Young 1989b). These three species—*T. laboriosa, O. salticus, P. audax*—are prime candidates for population augmentation by releases of field-captured or lab-reared individuals, or for population enhancement through habitat manipulations of field crops and adjacent plant communities. As an example of their potential importance, *P. audax* and *O. salticus* are key predators of *Heliothis* spp. and the fleahopper *Pseudatomoscelis seriatus* (Reuter) in cotton and adjacent habitats (Dean et al. 1987). By including field counts of these spiders in the TEXCIM cotton insect management model, predictions of pest abundance and subsequent action recommendations have been improved (Hartstack and Sterling 1988).

Prey of common crop-inhabiting spiders.—Prey choices have been documented for several of the abundant species that occur in agroecosystems (Table 4). *Oxyopes salticus* is known to capture the tarnished plant bug, *Lygus lineolaris* (Palisot) (Young and Lockley 1988), the imported fire ant, *Solenopsis invicta* Buren (Nyffeler et al. 1987a), the bollworm, *Heliothis zea* (Boddie) (Whitcomb 1967), and at least 15 other economically important field-crop pests (Young and Lockley 1985). Crop pests consumed by *P. audax*, besides the three just mentioned, include the spotted cucumber beetle, *Diabrotica undecimpunctata howardi* Barber, the three-cornered alfalfa hopper, *Spissistilus festinus* (Say), the boll weevil, *Anthonomus grandis* Boh., and numerous others (Young 1989b). *Pisaurina mira* (Walck.) (Pisauridae) preys on these six crop pests and also consumes the chinch bug, *Blissus* sp., the leafhopper *Chlorotettix* sp., the fall armyworm, *Spodoptera frugiperda* (J. E. Smith), and a variety of other arthropods (Young 1989c). These same crop pests are fed upon by many other common species of wandering spiders, such as *Metaphidippus galathea* (Walck.) (Salticidae), *Misumenops* spp. (Thomisidae), *Peucetia viridans* (Hentz) (Oxyopidae), *Pardosa milvina* (Hentz) (Lycosidae), and *Chiracanthium inclusum* (Hentz) (Clubionidae) (Plagens 1985; Howell and Pienkowski 1971; Whitcomb and Bell 1964). Small web-spinning spiders such as *T. laboriosa* seem to capture only small flies and aphids (Provencher and Coderre 1987; Whitcomb and Bell 1964), and spin a web that is easily destroyed by wind gusts (LeSar and Unzicker 1978). The common large orb-web spider, *Argiope aurantia* Lucas (Araneidae), spins a strong web capable of capturing large pests such as grasshoppers and scarab beetles, but mostly captures aphids and small flies (Nyffeler et al. 1987b). Thus the various web-spinning spiders that do occur in field crops may have little impact on the "medium-sized" crop pests such as plant bugs, boll weevils, and leaf beetles, and on the non-flying pests such as lepidopterous larvae.

Implications for spiders in IPM programs.—Several management strategies could have immediate positive impacts on spider populations in field crops and lead to increased levels of predation on crop pests. For example, reductions in both chemical applications and cultivation frequencies would kill fewer spiders and destroy fewer webs. Deployment of mulches, non-disturbance of weed covers, and strip planting of diverse crops all increase habitat diversity and consequently would support a larger and more diverse spider community. Augmentation of spider populations by placement of egg sacs in a field also may be feasible. If the pest-management strategy involved reduction of pest numbers in adjacent habitats, then perhaps the most efficient means for accomplishing this would be to conserve and enhance spider populations in these adjacent habitats. Reduction of mowing frequency and herbicide usage in crop margins, as well as the enlargement of such areas, may also result in increased spider populations (e.g., Young 1989a). Of course the easiest tactic to implement is non-intervention, with

Table 4.—Size ranges, hunting techniques, and habitats of the 42 most frequently occurring spiders in U. S. agroecosystems. a = data from Kaston 1978, 1981.

Taxon	Length of adult ♀ (mm)[a]	Hunting technique	Habitat & strata[a]	No. crop systems (out of 9)
ANYPHAENIDAE				
Aysha gracilis	6.4-7	Wand-Act	On foliage	6
ARANEIDAE				
Acanthepeira stellata	7-15	Web-Orb	Tall grass, low bushes	8
Argiope aurantia	19-28	Web-Orb	Tall grass, gardens	8
Argiope trifasciata	15-25	Web-Orb	Tall grass, sunny	7
Cyclosa turbinata	4.2-5	Web-Orb	Bushes	7
Gea heptagon	4.5-5.8	Web-Orb	Low grass & forbs	6
Glenognatha foxi	2	Web-Orb	Meadows & wastelands, low	6
Larinia directa	5-12	Web-Orb	Grass, sunny	7
Neoscona arabesca	5-12	Web-Orb	Tall grass, low bushes	7
Tetragnatha laboriosa	6	Web-Orb	Meadows, bushes, long grass	9
CLUBIONIDAE				
Chiracanthium inclusum	4.9-9.7	Wand-Act	On foliage	8
Clubiona abbotii	4-5.4	Wand-Act	On foliage	8
Trachelas deceptus	3.4-4.2	Wand-Act	Under loose tree bark, rolled up leaves	7
LINYPHIIDAE				
Eperigone tridentata	2.3	Web-Sheet	Under dead leaves in woods	6
Erigone autumnalis	1.4-1.7	Web-Sheet	Grass close to ground, under leaves	7
Florinda coccinea	3.5	Web-Sheet	In grass	7
Frontinella pyramitela	3-4	Web-Sheet	Tall grass, bushes in pine woods	6
Grammonota texana	2	Web-Sheet	Low grass & forbs	6
Meioneta micaria	1.9	Web-Sheet	Ground, low forbs	6
Tennesseellum formicum	1.8-2.5	Web-Sheet	In dead leaves on forest floor	8
Walckenaeria spiralis	2.5	Web-Sheet	Under dead leaves in woods	6
LYCOSIDAE				
Lycosa helluo	18-21	Wand-Act	Ground	7
Lycosa rabida	16-21	Wand-Act	Ground	6
Pardosa milvina	5.2-6.2	Wand-Act	Ground, herbs, low bushes	6
Pardosa pauxilla	4-4.5	Wand-Act	Ground	7
Schizocosa avida	10-15	Wand-Act	Ground	8
OXYOPIDAE				
Oxyopes salticus	5.7-6.7	Wand-Act	Low bushes, herbs	9
PHILODROMIDAE				
Tibellus oblongus	7-9	Wand-Act	Tall grass, bushes	6
PISAURIDAE				
Pisaurina mira	12.5-16.5	Wand-Act	Tall grass, bushes	6
SALTICIDAE				
Habronattus coecatus	5.5	Wand-Act	Ground, grass	6
Hentzia palmarum	4.7-6	Wand-Act	Tall grass, bushes & trees	7
Metaphidippus galathea	3.6-5.4	Wand-Act	Tall grass, bushes	8
Metaphidippus protervus	3.7-6.3	Wand-Act	Tall grass, bushes	6
Phidippus audax	8-15	Wand-Act	Tree trunks, under stones, bushes, tall grass, forbs	9

Phidippus clarus	8-10	Wand-Act	Tall grass, bushes	6
Zygoballus rufipes	3-6	Wand-Act	Dead leaves on ground, herbs, grass, low bushes	7
THERIDIIDAE				
Latrodectus mactans	8-10	Web-Ma	Close to ground	7
Theridion murarium	2.8-4	Web-Ma	Trees, bushes, grass, under stones	6
THOMISIDAE				
Misumenoides formocipes	5-11	Wand-Amb	Among flowers	6
Misumenops asperatus	4.4-6	Wand-Amb	In grass & foliage	8
Misumenops celer	5-6.7	Wand-Amb	Grassland flowers	8
Misumenops oblongus	4.9-6.2	Wand-Amb	Grass & weeds	8

no inputs of insecticides, biologicals, cultivations, or other manipulations. Nonintervention allows natural enemies such as spiders to develop unimpeded by man and exert natural controls over potential pest populations; such a tactic actually works in many situations (Sterling et al. 1989).

Both theoretical and empirical studies have demonstrated that generalist predators such as spiders can maintain prey populations at low densities (Post and Travis 1979; Kajak 1978). The conservation and enhancement of generalist (polyphagous) predators in field crops recently has been recommended (Luff 1983; Whitcomb 1981). Dean and Sterling (1987), however, point out the possible negative impacts of spiders on other natural enemies of crop pests, and call for detailed ecological studies to determine the roles of spiders in agroecosystems. Nyffeler and Benz (1987), in a world-wide survey of spiders as natural control agents, also point to the need for detailed ecological studies. Our review should provide the basis for further investigations of field-crop spiders associated with U. S. agroecosystems.

ACKNOWLEDGMENTS

The technical assistance of T. C. Lockley and M. S. Oltremari is gratefully appreciated. An exceptionally thorough manuscript review was provided by D. T. Jennings, with additional reviews by D. A. Dean, M. H. Greenstone, M. Nyffeler, D. B. Richman, S. H. Roach, and W. L. Sterling.

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Manuscript received February 1989, revised May 1989.

APPENDIX 1

SPIDERS IN NINE AGROECOSYSTEMS OF THE UNITED STATES

For list of information sources, See Appendix 2.

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
AGELENIDAE									
Agelenopsis aperta (Gertsch)			LA						
A. emertoni Chamb. & Ivie			LA				AR	DE	
A. kastoni Chamb. & Ivie								IL	
A. naevia (Walckenaer)			LA				LA,MS		
A. pensylvanica (C. L. Koch)							AL,AR	DE,KY	KY
A. spatula Chamb. & Ivie						TX			
Agelenopsis sp.	OK			FL,OH				FL,IA,IL	NY,VA
Cicurina arcuata (Keyserling)			LA				AR		
C. pallida Keys.								IL	
C. robusta Simon			LA						
Cicurina sp.							AL	KY	KY
Coras medicinalis (Hentz)			LA						
C. perplexus Muma			LA						
Coras sp.									KY
Cybaeus sp.								KY	
Tegenaria pagana C. L. Koch			LA						
Wadotes hybridus (Emerton)			LA						
AMAUROBIIDAE									
Titanoeca sp.									KY
ANYPHAENIDAE									
Anyphaena celer (Hentz)	OK		LA				AL,TX	KY	
A. laticeps Bryant							AR	FL	
A. maculata (Banks)							AR		
A. pectorosa L. Koch		TX						IL	VA
Anyphaena sp.		AR						DE,IA	NY
Aysha decepta (Banks)			LA					FL	
A. velox (Becker)			LA	FL					
A. gracilis (Hentz)	OK			FL	OK	TX	AL,AR, LA,MS,TX,	DE,FL IL	
Aysha sp.		AR			TX			KY	
Oxysoma cubana Banks								IL	VA
Teudis mordax (O. P.-Cambridge)				FL			TX		
Wilfila saltabunda (Hentz)			LA	FL			AL,MS,TX	IL	NY,VA
Wulfila sp.								DE,KY	KY
ARANEIDAE									
Acacesia hamata (Hentz)				FL			AL,AR,TX	FL	VA
Acanthepeira cherokee Levi							TX		
A. stellata (Walck.)	OK	TX	LA		OK,TX	TX	AL,AR, MS,TX	FL,IL, KY,LA, MO,NC	KY,NY,VA
A. venusta (Banks)							AR		
Acanthepeira sp.				FL	TX			DE,NC	
Alpaida calix (Walck.)							AL		
Araneus guttulatus (Walck.)								IL	
A. juniperi (Emerton)								DE	VA
A. marmoreus Clerck									NY
A. miniatus (Walck.)				FL					
A. nordmanni (Thorell)							AL		
A. pegnia (Walck.)				FL					
A. pratensis (Emerton)									NY
A. thaddeus (Hentz)				OH			AR		
A. trifolium (Hentz)									NY,VA
Araneus sp.	OK			FL,OH	TX		TX	DE,FL, IA,KY,NC	KY,NY,VA
Araniella displicata (Hentz)	OK	TX					AL,AR,LA	IL	NY,VA
Araniella sp.					TX				
Argiope aurantia Lucas	OK	AR	LA	FL,OH		TX	AR,TX	DE,IA,IL, KY,LA,NC	VA
A. trifasciata (Forskal)	OK			FL,OH	TX	TX	AR,TX	FL,IL, KY,NC	KY,NY,VA

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
Argiope sp.								FL	
Cyclosa caroli (Hentz)				FL					
C. conica (Pallas)		TX					AL		VA
C. turbinata (Walck.)	OK		LA	FL		TX	AR,TX	KY	KY,VA
Cyclosa sp.					TX			NC	NY
Eriophora ravilla (C. L. Koch)				FL			TX		
Eustala anastera (Walck.)				FL,OH	OK,TX	TX	AL,AR,TX		VA
E. cepina (Walck.)									NY
Eustala sp.	OK							DE,KY	
Gasteracantha cancriformis (L.)				FL					
Gea heptagon (Hentz)		AR,TX	LA	FL			AL,LA,TX	DE, FL, KY,NC	KY,VA
Glenognatha foxi (McCook)		AR	LA			TX	AR,TX	DE,IL,KY	KY,NY,VA
Hypsosinga pygmaea (Sundevall)			LA		TX				
H. rubens (Hentz)				FL		TX	TX	FL	
Larinia directa Hentz		TX	LA	FL		TX	AL	MO,NC	VA
Larinia sp.	OK							NC	NY
Leucauge venusta (Walck.)			LA	FL			AR,LA	DE,FL,MO	
Leucauge sp.								KY	KY
Mangora gibberosa (Hentz)	OK			FL,OH			AR,TX	DE,NC	NY,VA
M. maculata (Keys.)							AL		
M. placida (Hentz)			LA				AL		
M. spiculata (Hentz)				FL					
Mangora sp.								KY	
Mecynogea lemniscata (Walck.)			LA	FL		TX	AL,AR,TX	FL	
Metazygia wittfeldae (McCook)			LA				MS,TX		
Metepeira labyrinthea (Hentz)	OK					TX	AR,MS		VA
Metepeira sp.		TX			TX			DE	
Micrathena gracilis (Walck.)							AL,AR, MS,TX		VA
M. sagittata (Walck.)				FL					
Micrathena sp.								FL	
Neoscona arabesca (Walck.)		AR,TX	LA	FL,OH		TX	AL,AR, LA,MS, TX	DE,FL, IL,KY,LA, MO,NC	KY,NY,VA
N. domiciliorum (Hentz)		TX	LA				AL		
N. hentzii (Keys.)			LA		OK		AR		
N. oaxacensis (Keys.)					OK,TX		TX		CA
N. pratensis (Hentz)		TX		OH			AL		
N. utahana (Chamberlin)							TX		
Neoscona sp.	OK				TX		CA	FL,MO,NC	
Nephila clavipes (L.)								FL	
Nuctenea cornuta (Clerck)							AL		
N. sclopetaria (Clerck)							AL		
Nuctenea sp.								KY	KY
Pachygnatha autumnalis Keys.			LA		LA			DE,KY	KY,VA
P. tristriata C. L. Koch								KY	KY,NY,VA
Pachygnatha sp.					TX				
Scoloderus cordatus (Taczanowski)			LA	FL					
Tetragnatha caudata Emerton				FL					
T. elongata (Walck.)							AL,AR,MS	MO	
T. laboriosa Hentz	OK	AR,TX	LA	FL,OH	OK,TX	TX	AL,AR, LA,MS,TX	DE,FL,IA, IL,KY, NC	CA,KY, NY
T. pallescens F.O.P.-Camb.		AR						LA	
T. straminea Emerton		TX					AL,LA	IL	
T. versicolor Walck.		TX					AL		
Tetragnatha sp.					TX		CA	FL,MO,NC	
Verrucosa arenata (Walck.)							AR		
Wagneriana tauricornis (O.P.-Camb.)				FL					
Wixia ectypa (Walck.)									VA

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
Wixia sp.							AR		
Zygiella dispar (Kulczynski)							AL		
CLUBIONIDAE									
Agroeca pratensis Emerton							AL		VA
A. trivittata (Keys.)									CA
Agroeca sp.								KY	
Castianeira alteranda Gertsch						TX			
C. amoena (C.L. Koch)						TX			
C. crocata (Hentz)								LA	
C. descripta (Hentz)			LA	OH		TX	AL,AR	IL	
C. floridana (Banks)								FL	
C. gertschi Kaston							AL,TX	FL	
C. longipalpus (Hentz)			LA			TX	AL,AR LA,TX	FL,LA	
C. occidens Reiskind						TX			
C. variata Gertsch			LA						VA
Castianeira sp.	OK			FL	TX			IA,KY	KY
Chiracanthium inclusum (Hentz)	OK		LA	FL	TX	TX	AL,AR, MS,TX	DE,FL, IL,KY,NC	VA
C. mildei L. Koch							AL	IL	
Chiracanthium sp.									NY
Clubiona abbotii L. Koch	OK	AR	LA	FL		TX	AL,AR,LA	DE,IL, KY,NC	KY,NY,VA
C. catawba Gertsch							AR	DE	VA
C. johnsoni Gertsch		TX					AR		
C. kagani Gertsch							TX		
C. maritima L. Koch			LA				AL		
C. obesa Hentz			LA				AL		NY
C. pikei Gertsch									VA
C. plumbi Gertsch		TX							
C. procteri Gertsch				FL					
C. pygmaea Banks								FL	
C. riparia L. Koch		TX							
C. saltitans Emerton							AR	DE	
C. spiralis Emerton									VA
Clubiona sp.		TX		OH				DE,IA, KY,NC	KY
Clubionoides excepta (L. Koch)							AL		
Myrmecotypus lineatus (Emerton)				FL				FL	
Phrurotimpus alarius (Hentz)			LA				AR		
P. borealis (Emerton)			LA			TX			
P. emertoni Gertsch			LA						
P. minutus (Banks)			LA	FL				FL	
Phrurotimpus sp.									KY
Scotinella fratella (Gertsch)			LA				AR		
S. pallida Banks							AR		
Scotinella sp.				FL				KY	KY
Strotarchus piscatoria (Hentz)							AL	FL	
Syrisca affinis (Banks)						TX	TX		
Trachelas deceptus (Banks)		AR	LA	FL		TX	AR,LA,TX	FL,LA	VA
T. similis F.O.P.-Camb.			LA	FL				LA	LA
T. tranquillus (Hentz)			LA				AL,AR,MS LA,TX	KY	KY,NY
T. volutus Gertsch									
Trachelas sp.								KY,NC	KY
DICTYNIDAE									
Argenna obesa Emerton								IL	NY
Dictyna annexa Gertsch & Mulaik						TX			
D. bellans Chamberlin						TX			
D. bicornis Emerton	OK					TX			
D. bostoniensis Emerton						TX			
D. consulta Gertsch & Ivie						TX			
D. foliacea (Hentz)									NY
D. hentzi Kaston							AR		NY
D. hoya Chamb. & Ivie									CA
D. iviei Gertsch & Mulaik						TX			
D. longispina Emerton				OH			TX		

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
D. manitoba Ivie									NY
D. reticulata Gertsch & Ivie							CA		CA
D. segregata Gertsch & Mulaik	OK					TX	AR,LA,TX		
D. sublata Hentz			LA			TX		MO	
D. volucripes Keys.					TX	TX	AL,AR,TX		NY,VA
Dictyna sp.	OK	AR		FL,OH	TX	TX		FL,KY	KY
Tricholathys hirsutipes (Banks)									CA
DYSDERIDAE									
Ariadna sp.									KY
Dysdera crocata C. L. Koch			LA						
FILISTATIDAE									
Kukulcania hibernalis (Hentz)							AR,TX	LA	
GNAPHOSIDAE									
Cesonia bilineata (Hentz)			LA				AL		
C. sincera Gertsch & Mulaik						TX			
Drassodes auriculoides Barrows							AR		
D. gosiutus Chamberlin							AR,LA		
Drassodes sp.				FL			AL,TX	DE,KY	KY
Drassyllus creolus Chamb. & Gert.	OK						AR		
D. depressus (Emerton)								IL,KY	KY
D. fallens Chamberlin							AR		
D. gynosaphes Chamberlin			LA				AR		
D. lepidus (Banks)	OK					TX	AR		
D. notonus Chamberlin						TX	LA,TX		
D. orgilus Chamberlin						TX			
Drassyllus sp.	OK			FL	TX		AL,AR,TX		CA,VA
Gnaphosa fontinalis Keys.						TX			
G. sericata (L. Koch)			LA	FL		TX	AR,TX	IL,KY	
Haplodrassus signifer (C. L. Koch)						TX			
Haplodrassus sp.					TX				
Herpyllus ecclesiasticus Hentz			LA						
Micaria aurata (Hentz)							AL		
M. triangulosa Gertsch						TX			
M. vinnula Gertsch & Davis							AR		
Micaria sp.				FL		TX			CA
Nodocion floridanus (Banks)							TX		
N. rufithoracicus Worley						TX			
Sergiolus capulatus (Walck.)				FL				IL,NC	
S. lowelli Chamb. & Woodbury						TX			
S. minutus (Banks)			LA				AR		
S. ocellatus (Walck.)			LA				TX		
Sergiolus sp.	OK						MS		KY
Synaphosus paludis (Chamb. & Gert.)			LA				TX	LA	
Urozelotes rusticus (L. Koch)			LA						
Zelotes duplex Chamberlin							AR		
Z. gertschi Platnick & Shadab						TX			
Z. hentzi Barrows	OK						AR,LA		
Z. laccus (Barrows)							AR	IL	
Z. pseustes Chamberlin						TX			
Z. subterraneus (C. L. Koch)							AR		
Zelotes sp.	OK							FL,KY	
HAHNIIDAE									
Neoantistea agilis (Keys.)			LA				AR	IL,KY	KY
N. mulaiki Gertsch						TX	TX		
N. riparia (Keys.)									VA
Neoantistea sp.				FL				DE	
LINYPHIIDAE									
Anibontes longipes Chamb. & Ivie				FL					
Bathyphantes albiventris (Banks)				OH					VA

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
B. concolor (Wider)									NY
B. pallidus (Banks)								KY	KY
Bathyphantes sp.							AR	DE	
Centromerus cornupalpis (O.P.-Camb.)									NY
Centromerus sp.							AR		
Ceraticelus bryantae Kaston			LA						
C. creolus Chamberlin							AR		
C. emertoni (O.P.-Camb.)							AL		NY
C. formosus Cros. & Bishop				OH			AL		
C. similis (Banks)		AR		FL	TX			DE	NY,VA
Ceraticelus sp.		AR		FL			TX	FL	
Ceratinella placida Banks								KY	KY
Ceratinops crenata Emerton				FL		TX			
C. rugosa (Emerton)			LA					IL	
Ceratinops sp.								FL	
Ceratinopsidis formosa (Banks)									NY
Ceratinopsis laticeps (Emerton)								IL,KY	KY
C. nigriceps Emerton								IL	
C. sutoris Cros. & Bishop				FL					
Ceratinopsis sp.		AR				TX			
Collinsia plumosus (Emerton)								IL	CA
Eperigone albula Zorsch & Crosby			LA						
E. banksi Ivie & Barrows		AR	LA	FL	TX			FL	
E. eschatologica (Crosby)							CA		
E. maculata (Banks)							AR		
E. tridentata (Emerton)	OK	AR	LA				AR	IL	KY,VA
E. trilobata (Emerton)	OK						AR	IL,KY	KY,VA
Eperigone sp.						TX			
Eridantes erigonoides (Emerton)								KY	KY,NY,VA
Erigone atra Blackwall								IL	
E. autumnalis Emerton	OK		LA	FL		TX	AR,TX	DE,FL, IL,KY	KY,NY,VA
E. barrowsi Crosby & Bishop	OK					TX			
E. blaesa Crosby & Bishop								DE,KY	KY,NY
E. dentigera O.P.-Cambridge		AR					TX		
E. dentosa O.P.-Cambridge							CA		CA
E. praecursa Chamb. & Ivie							AR		
Erigone sp.	OK		LA						
Floricomus sp.							AR		
Florinda coccinea (Hentz)	OK	AR	LA	FL			AL,AR	DE,FL, KY,MO,NC	KY
Frontinella pyramitela (Walck.)	OK		LA	FL			AL,AR,TX	DE,FL, IL,KY	KY,VA
Gonatium rubens (Balckwall)							AR		
Grammonota capitata Emerton								KY	KY
G. inornata Emerton	OK	AR					AR	DE,IL,KY	KY,NY,VA
G. pictilis (O.P.-Camb.)									NY
G. texana (Banks)	OK	AR	LA	FL		TX	AR,TX		
Helophora sp.								DE	
Hypselistes florens (O.P.-Camb.)									NY
Islandiana flaveola (Banks)	OK						AR	DE	VA
Lepthyphantes nebulosa (Sundevall)			LA						
L. sabulosa (Keys.)							AR		
Lepthyphantes sp.								MO	
Linyphantes aeronauticus (Petrunk.)									CA
Meioneta angulata (Emerton)									VA
M. barrowsi Chamb. & Ivie								DE	
M. dactylata Chamb. & Ivie								KY	KY
M. fabra (Keys.)								DE,IL	VA
M. maculata (Banks)									VA

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
M. meridionalis Cros. & Bishop							AR		
M. micaria (Emerton)	OK			FL		TX	AR	IL,KY	KY,VA
M. nigripes (Simon)									NY
M. unimaculata (Banks)								IL,KY	KY,VA
Meioneta sp.	OK		LA	FL	TX	TX	AL,TX		NY,VA
Microlinyphia mandibulata (Emer.)									CA,NY,VA
M. pusilla (Sundevall)								IL,KY	KY
Microneta sp.			LA						
Neriene clathrata Sundevall									NY
N. maculata (Emerton)							AL,AR		VA
N. radiata (Walck.)						TX	AR		
Neriene sp.								FL	
Pimoa sp.									KY
Scylaeceus pallidus (Emerton)	OK								
Spirembolus phylax Chamb. & Ivie							CA		CA
Tapinocyba scopulifera (Emerton)								IL	
Tennesseellum formicum (Emerton)	OK		LA	FL	TX	TX	AL,AR	DE,IL, KY	CA,KY,NY
Walckenaeria pallida Emerton							AL		
W. puella Millidge						TX			
W. spiralis (Emerton)	OK		LA			TX	AR	IL,KY	CA,KY,NY, VA
LYCOSIDAE									
Allocosa absoluta (Gertsch)						TX			
A. floridiana (Chamberlin)			LA	FL					
A. funerea (Hentz)			LA				AR,LA	DE,KY	KY,VA
A. mokiensis (Gertsch)									CA
A. sublata (Montgomery)							AR		
Allocosa sp.							TX		
Arctosa littoralis (Hentz)						TX	LA		
Arctosa sp.							CA		NY
Geolycosa riograndae Wallace						TX			
Geolycosa sp.	OK								
Gladicosa gulosa Walck.	OK						AR		
Lycosa acompa (Chamberlin)			LA				AR		
L. ammophila Wallace				FL					
L. annexa Chamb. & Ivie							AR	FL	
L. antelucana Montgomery	OK		LA			TX	AR		
L. aspersa Hentz			LA						
L. baltimoriana (Keys.)	OK								
L. carolinensis Walck.			LA	FL			AR	KY	KY
L. frondicola Emerton								KY	KY
L. georgicola Walck.			LA						
L. helluo Walck.	OK	TX	LA	FL			AR,LA,TX	DE,FL, KY,LA	NY,NY,VA
L. lenta Hentz			LA	FL				FL	
L. modesta (Keys.)									KY
L. punctulata (Hentz)	OK		LA				AL,AR	DE,FL,NC	KY
L. rabida Walck.			LA	FL		TX	AL,AR, LA,TX	DE,FL, KY,NC	KY,VA
L. ripariola Bonnet								KY	KY
L. timuqua Wallace								FL	
Lycosa sp.	OK	AR		OH	TX			DE,KY,NC	CA,KY
Pardosa atlantica Emerton/ *P. saxatilis* (Hentz)		AR,TX	LA				AL,AR	DE,IA,KY	KY,VA
P. delicatula Gert. & Wall.	OK		LA		TX		LA,TX		
P. distincta (Blackwall)		TX					AL,LA,MS	MO,NC	VA
P. littoralis Banks				FL			AL	FL	VA
P. mercurialis Montgomery						TX			
P. milvina (Hentz)		AR,TX	LA	FL			AL,AR, LA,TX	DE,FL, IL,KY, LA,NC	KY,NY,VA
P. modica (Blackwall)									NY
P. moesta Banks			LA						NY

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
P. montgomeryi Gertsch			LA						
P. parvula Banks				FL				FL	
P. pauxilla Montgomery	OK			FL	TX	TX	AR,LA,TX	FL	VA
P. ramulosa (McCook)							CA		CA
Pardosa sp.	OK				TX			NC	VA
Pirata alachuus Gert. & Wallace		AR					AR		
P. allapahae Gertsch				FL					
P. insularis Emerton		TX					AL	DE	VA
P. minutus Emerton			LA					DE	NY,VA
P. piraticus (Clerck)			LA					KY	KY
P. sedentarius Montgomery		AR					AR		
P. seminola Gertsch & Wallace		AR					TX		
P. suwaneus Gertsch		AR	LA				AR		
P. sylvanus Chamb. & Ivie			LA					AR	
Pirata sp.	OK			FL				DE	KY
Schizocosa avida (Walck.)	OK	TX	LA	OH		TX	AR,LA,TX	DE,KY	KY,VA
S. bilineata (Emerton)	OK						AL	DE,KY	KY,VA
S. crassipes (Walck.)			LA				AR	FL,KY	KY
S. ocreata (Hentz)	OK		LA				AR,LA	DE,FL,LA	
S. retrorsa (Banks)							AR		
Schizocosa sp.	OK						CA		VA
Trabeops sp.							AL		
Trochosa avara (Keys.)								FL	
T. shenandoa Chamb. & Ivie						TX			
T. terricola (Thorell)		TX					AL		
Trochosa sp.	OK	AR							
MIMETIDAE									
Ero leonina (Hentz)				FL					
Mimetus epeiroides Emerton							AR,MS	IL,KY, NC	KY,NY,VA
M. hesperus (Chamberlin)			LA			TX	TX		
M. nelsoni (Archer)								FL	
M. notius Chamberlin						TX		FL	
M. puritanus Chamberlin							AL,MS		
Mimetus sp.				FL				DE,NC	CA
MYSMENIDAE									
Mysmena guttata (Banks)			LA						
NESTICIDAE									
Eidmannella pallida (Emerton)	OK		LA				AR		CA
OECOBIIDAE									
Oecobius cellariorum (Duges)		AR							
Oecobius sp.									KY
OXYOPIDAE									
Hamataliwa helia (Chamberlin)								FL	
Oxyopes aglossus Chamberlin							AR		
O. apollo Brady	OK					TX	TX	FL	
O. salticus Hentz	OK	AR,TX	LA	FL	TX	TX	AL,AR, LA,MS TX	DE,FL, IA,IL, KY,LA, MO,NC,	CA,KY,VA
O. scalaris Hentz		TX					AL	FL,IL	
Peucetia viridans (Hentz)		TX		FL		TX	AL,AR, MS,TX	FL,LA, NC	
PHILODROMIDAE									
Apollophanes texanus Banks							MS		
Ebo albocaudatus Schick						TX			
E. latithorax Keys.	OK							MO	
E. pepinensis Gertsch									CA
E. punctatus Sauer & Platnick						TX			
Ebo sp.					TX		TX	KY	KY
Philodromus cespitum (Walck.)								DE,IL	
P. histrio (Latr.)									CA
P. imbecillus Keys.							AL		
P. infuscatus Keys.							TX		

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
P. keyserlingi Marx				FL		TX	AL	IL	
P. marxi Keys.								IL	
P. minutus Banks						TX			VA
P. pernix Blackwall							MS		
P. placidus Banks									NY
P. pratariae (Schick)						TX	TX		
P. rufus Walck.							AL	DE	NY
P. satullus Keys.							AR		
P. vulgaris (Hentz)							AR,IA		
Philodromus sp.	OK				TX			DE,KY, NC	KY,VA
Thanatus formicinus (Clerck)						TX	AL,LA, TX	IL	VA
T. rubicellus M. Leitas							AR		
T. striatus (C. L. Koch)							AL		
Thanatus sp.	OK			OH				DE	VA
Tibellus duttoni (Hentz)						TX	AR,TX		
T. maritimus (Menge)		TX							
T. oblongus (Walck.)		TX		OH	TX		AL	IA,IL, KY	CA,KY, NY,VA
Tibellus sp.								DE,FL,NC	VA
PHOLCIDAE									
Pholcus phalangioides (Fueselin)			LA						
Psilochorus redemptus Gert. & Mulaik						TX			
Psilochorus sp.							CA		
PISAURIDAE									
Dolomedes albineus Hentz			LA						
D. scriptus Hentz		TX	LA						
D. tenebrosus Hentz		TX							
D. triton (Walck.)		AR,TX					AL,AR, LA,TX	FL,MO	
Dolomedes sp.				FL				NC	KY
Pisaurina brevipes (Emerton)								IL	
P. dubia (Hentz)			LA						
P. mira (Walck.)		TX	LA			TX	AL,AR,LA	DE,FL, IL,KY	KY,NY
Pisaurina sp.	OK			FL				DE,KY	
SALTICIDAE									
Admestina tibialis (C. Koch)							TX		
Agassa cyanea (Hentz)								IL	VA
Ballus youngii G. & E. Peckham							AL		
Corythalia canosa (Walck.)			LA	FL					
Eris aurantia (Lucas)							AL,AR,MS	FL,NC	VA
E. militaris (Hentz)			LA			TX	AL,LA, MS,TX	IL,KY,LA	VA
E. pinea (Kaston)							AL	IL	
Eris sp.					TX			DE,MO	KY
Euophrys sp.									VA
Evarcha hoyi (G. & E. Peckham)							AL	MO	VA
Habrocestum pulex (Hentz)							LA,MS		
Habrocestum sp.								DE	
Habronattus agilis (Banks)						TX	AL,LA		
H. borealis (Banks)		AR	LA				AL,MS		
H. brunneus (G. & E. Peckham)				FL					
H. calcaratus Banks							AL		
H. coecatus (Hentz)	OK		LA			TX	AL,AR, LA,MS,TX	LA,NC	CA,VA
H. decorus (Blackwall)							AL		NY
H. mustaciatus Chamb. & Ivie									CA
H. texanus (Chamberlin)	OK					TX		IL	
H. trimaculatus Bryant				FL					
H. viridipes (Hentz)	OK						AL,LA,MS		
Habronattus sp.							AL	MO	KY

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
Hentzia mitrata (Hentz)			LA				AL,AR, TX	DE,FL,NC	
H. palmarum (Hentz)			LA	FL	TX	TX	AL,AR, LA,MS,TX	DE,FL, IL,NC	VA
Hentzia sp.	OK							DE,KY,NC	
Lyssomanes viridis (Walck.)				FL			AL,TX		
Maevia inclemens (Walck.)						TX	AL,LA		
Marpissa bina (Hentz)									VA
M. dentoides Barnes				FL					
M. formosa (Banks)		TX					TX		
M. lineata (C. L. Koch)						TX	TX		VA
M. pikei (G. & E. Peckham)						TX	LA		VA
Marpissa sp.							AL		
Metacyrba taeniola (Hentz)							AR		
Metacyrba sp.								DE	KY
Metaphidippus castaneus (Hentz)							AL		
M. exiguus (Banks)							TX		
M. galathea (Walck.)	OK		LA	FL	TX	TX	AR,LA, MS,TX	FL,IL,KY, LA,MO,NC	NY,VA
M. insignis (Banks)	OK						AL,AR,TX		
M. manni G. & E. Peckham							CA		
M. protervus (Walck.)		AR	LA	OH			AL,AR, LA,MS	IA,IL	NY,VA
M. vitis Cockerell		TX					AR,TX		
Metaphidippus sp.	OK							DE,FL,KY, MO,NC	
Neon sp.								DE	
Neonella vinnula Gertsch							TX		
Peckhamia americana (G. & E. Peckham)				FL					
P. picata (Hentz)	OK					TX	AR		
Peckhamia sp.								KY	KY
Pellenes limatus G. & E. Peckham						TX			
Phidippus apacheanus Chamb. & Gert.				FL		TX	LA		
P. audax (Hentz)	OK	TX	LA	FL	OK,TX	TX	AL,AR, LA,MS,TX	FL,IL, KY,LA, MO,NC	KY,NY,VA
P. cardinalis (Hentz)					TX	TX	AR,LA,TX		
P. carolinensis G. & E. Peckham							AR		
P. clarus Keys.			LA	FL,OH		TX	AL,AR, LA,MS,TX	FL,LA, MO,NC	VA
P. insignarius C. L. Koch							AL		
P. mystaceus (Hentz)							AR		
P. pius Schick						TX			
P. princeps (G. & E. Peckham)				OH			AL		NY
P. pulcherrimus Keys.				FL					
P. purpuratus Keys.							AL,AR	MO	
P. putnami (G. & E. Peckham)				FL					
P. regius, C. L. Koch				FL			AL	FL	
P. texanus Banks						TX	TX		
Phidippus sp.				OH	OK,TX			DE,FL, IA,MO,NC	CA,KY,VA
Phlegra fasciata ((Hahn)							AL		
Platycryptus undatus (DeGeer)							AL,AR, MS,TX		
Plexippus paykulli (Audouin)							AL		
Plexippus sp.								MO	
Salticus sp.					TX				
Sarinda hentzi (Banks)			LA				TX		KY
Sassacus papenhoei G. & E. Peckham	OK				TX	TX	TX		
Sitticus cursor Barrows							AL	KY	VA
S. dorsatus (Banks)						TX			

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
S. pubescens (Fabr.)							AL		
Sitticus sp.								DE	KY
Synageles sp.				FL					
Synemosyna formica Hentz			LA				AL,AR		
Talavera minuta (Banks)									NY
Thiodina puerpera (Hentz)	OK	TX				TX	AL,AR,TX	LA	
T. sylvana (Hentz)		TX					AL,MS,TX	FL,MO	
Thiodina sp.				FL				NC	
Tutelina elegans (Hentz)	OK						AL	IL	
T. harti (Emerton)								NY	
Tutelina sp.				OH			AL		
Zygoballus nervosus (G. & E. Peckham)		AR					AR,TX		
Z. rufipes G. & E. Peckham		AR	LA	FL		TX	AL,AR, MS,TX	DE,FL	VA
Z. sexpunctatus (Hentz)		AR					AL,LA,MS	FL,NC	VA
Zygoballus sp.								IA,MO,NC	
THERIDIIDAE									
Achaearanea globosa (Hentz)				FL			AL,AR,TX		
A. tepidariorum (C. L. Koch)							LA	FL	VA
Achaearanea sp.		AR		FL				KY	KY
Anelosimus studiosus (Hentz)				FL			TX		
Argyrodes cancellatus (Hentz)							AL		
A. fictilium (Hentz)			LA	FL				KY	
A. trigonum (Hentz)							TX		NY
Argyrodes sp.				FL				DE	
Chrysso sp.								FL	
Coleosoma acutiventer (Keys.)			LA	FL					
Coleosoma sp.								FL	
Crustulina sticta (O.P.-Camb.)									CA
Dipoena abdita Gertsch & Mulaik			LA						
D. nigra (Emerton)							AR,LA,MS		
Dipoena sp.					TX		AL		KY
Enoplognatha marmorata (Hentz)							AL		
E. ovata (Clerck)									NY
Euryopis funebris (Hentz)							AL,MS	KY	KY,VA
E. gertschi Levi									VA
E. texana Banks						TX			
Euryopis sp.								DE	
Latrodectus hesperus Chamb. & Ivie									CA
L. mactans (Fabr.)	OK		LA	FL	TX	TX	AL,AR,CA LA,MS,TX	FL,KY, LA,NC	
L. variolus (Walck.)							LA		
Paratheridula perniciosa (Keys.)			LA					FL	
R. fuscus Emerton			LA						
Robertus sp.							AL,MS		
Steatoda albomaculata (DeGeer)							MS		
S. americana (Emerton)								KY	KY
S. erigoniformis (O.P.-Camb.)				FL					
S. fulva (Keys.)						TX			
S. grossa (C. L. Koch)			LA						
S. medialis (Banks)						TX			
S. quadrimaculata (O.P.-Camb.)				FL					
S. transversa (Banks)						TX			
S. triangulosa (Walck.)			LA			TX	AL,TX		
Steatoda sp.					TX				
Theridion alabamense Gert. & Archer			LA						

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
T. albidum Banks		LA	FL				DE,IL, KY,NC	KY,VA	
T. australe Banks						TX	AR,TX	DE,KY	KY
T. cheimatos Gert. & Archer								DE	KY
T. cinctipes Banks						TX			
T. crispulum Simon				FL		TX	AR		
T. differens Emerton				OH			AR	KY,NC	NY,VA
T. flavonotatum Becker				FL					
T. frondeum Hentz							AL,AR,MS	FL,IL, KY	KY,NY
T. glaucescens Becker	OK		LA				TX		
T. hidalgo Levi						TX			
T. llano Levi						TX			
T. lyricum Walck.								DE,KY	
T. murarium Emerton	OK		LA			TX	TX	DE,NC	NY
T. neshamini Levi							AR	DE,IL,KY	KY,VA
T. pennsylvanicum Emerton									VA
T. pictipes Keys.				FL			AR	FL,NC	
T. rabuni Chamb. & Ivie	OK					TX	AR	DE,IL	CA,VA
T. sexpunctatum Emerton								KY	
Theridion sp.					TX			DE,KY,NC	KY
Theridula emertoni Levi							AL	DE,KY	KY
T. opulenta (Walck.)			LA	FL			AL,AR,MS	FL,IL, KY,NC	KY,VA
Thymoites expulsus (Gert. & Mulaik)			LA			TX			
T. unimaculatus (Emerton)							AL	IL	NY
Thymoites sp.								DE	
Tidarren sisyphoides (Walck.)			LA				TX		
Tidarren sp.				FL				DE	
THERIDIOSOMATIDAE									
Theridiosoma gemmosum (L. Koch)				FL					
THOMISIDAE									
Coriarachne floridana Banks							LA		
C. versicolor (Keys.)				OH			AL,AR,LA		
Coriarachne sp.								DE,NC	
Misumena vatia (Clerck)		TX					AL,MS	FL,IL, KY,NC	NY
Misumena sp.				OH				NC	
Misumenoides formosipes (Walck.)				FL	OK,TX	TX	AL,AR, MS,TX	FL,IL, KY,LA, MO,NC	NY,VA
Misumenoides sp.								DE	
Misumenops asperatus (Hentz)	OK	TX	LA	OH		TX	AL,AR MS,TX	FL,IA,IL KY,MO	KY,NY,VA
M. celer (Hentz)	OK	TX	LA	FL	OK,TX	TX	AL,AR, MS,TX	FL,LA,NC	
M. deserti Schick							CA		CA
M. dubius Keys.							TX		
M. lepidus (Thorell)									CA
M. oblongus (Keys.)	OK	AR,TX	LA	FL		TX	AL,AR,LA, MS,TX	LA	CA,VA
Misumenops sp.	OK	AR			OK,TX			DE,KY, MO,NC	KY
Ozyptila conspurcata (Thorell)							AL		
O. creola Gertsch		AR							
O. monroensis Keys.							AR		
Ozyptial sp.	OK							KY	
Synaema bicolor Keys.							AL		
S. parvula (Hentz)							AL,AR, MS,TX	KY,NC	VA
Synaema sp.								DE	NY
Tmarus angulatus (Walck.)						TX			NY,VA
Tmarus sp.							MS,TX	DE	
Xysticus auctificus Keys.							AR,TX	IL,KY	KY,VA
X. bicuspis Keys.							AL		

Taxon	Grain sorghum	Rice	Sugar-cane	Corn	Guar	Peanuts	Cotton	Soybean	Alfalfa
X. californicus Keys.							CA		CA
X. concursus Gertsch						TX			
X. discursans Keys.								KY	KY,NY,VA
X. elegans Keys.							AL,TX	IL	
X. ferox (Hentz)			LA					IL,KY	KY
X. fraternus Banks								IL	
X. funestus Keys.						TX	AR,LA,TX	KY	KY,NY
X. furtivus Gertsch									VA
X. gulosus Keys.						TX	AL	NC	NY
X. luctans (C. L. Koch)									NY
X. pellax O.P.-Camb.						TX			
X. texanus Banks			LA		TX	AR,TX	KY	KY	
X. transversatus (Walck.)							AL		VA
X. triguttatus Keys.							AL	KY,MO	KY,VA
Xysticus sp.	OK	AR		FL,OH	TX		AL,MS	DE,IA,KY, MO,NC	KY,VA
ULOBORIDAE									
Hyptiotes cavatus (Hentz)							AR		
Uloborus glomosus (Walck.)			LA	FL		TX	AL,AR,LA	IL	
Uloborus sp.	OK			FL					
ZORIDAE									
Zora pumila (Hentz)							AL		
Totals = 614 taxonomic entries	88	75	137	136	52	131	308	262	233

APPENDIX 2

Information sources for Appendix 1. Letter and number annotations refer to categories as listed in Table 1.

GRAIN SORGHUM

OK Bailey, C. L. and H. L. Chada. 1968. Spider populations in grain sorghums. Ann. Entomol. Soc. America, 61:567-571.
[A - 1; B - 4; C - 1; D - 1; E - 3,4,5; F - 2.]

RICE

AR Heiss, J. S. and M. V. Meisch. 1985. Spiders (Araneae) associated with rice in Arkansas with notes on species compositions of populations. Southw. Natur., 30:119-127.
[A - 4; B - 3; C - 1; D - 9; E - 1,6; F - 1.]

TX Woods, M. W. and R. C. Harrel. 1976. Spider populations of a southeast Texas rice field. Southw. Natur., 21:37-48.
[A - 1; B - 9; C - 1; D - 1; E - 1,3,4; F - 2.]

SUGARCANE

LA Ali, A. D. and T. E. Reagan. 1985. Spider inhabitants of sugarcane ecosystems in Louisiana: An update. Proc. Louisiana Acad. Sci., 48:18-22.
[A - 3; B - ?; C - 1; D - ?; E - 1,2,3,4; F - 1.]

LA Negm, A. A., S. D. Hensley and L. R. Roddy. 1969. A list of spiders in sugarcane fields in Louisiana. Proc. Louisiana Acad. Sci., 32:50-52.
[A - 10; B - 6; C - 1,2; D - 8; E - 1,3,4; F - 2.]

CORN

FL Plagens, M. J. 1985. The corn field spider community: Composition, structure, development and function. Ph.D. Thesis, Univ. Florida, Gainesville. 207 pp.
[A - 3; B - 12; C - 1; D - 6; E - 4; F - 1]

OH Everly, R. T. 1938. Spiders and insects found associated with sweet corn with notes on the food and habits of some species. I. Arachnida and Coleoptera. Ohio J. Sci., 38:136-148.
[A - 1; B - 3; C - 1; D - 1; E - 4; F - 1.]

GUAR

OK, TX Rogers, C. E. and N. V. Horner. 1977. Spiders of guar in Texas and Oklahoma. Environ. Entomol., 6:523-524.
[A - 3; B - ?; C - 1; D - ?; E - 1,3,4; F - 1.]

PEANUTS

TX Agnew, C. W., D. A. Dean and J. W. Smith, Jr. 1985. Spiders collected from peanuts and non-agricultural habitats in the Texas west cross-timbers. Southw. Natur., 30:1-12.
[A - 3; B - 4; C - 1; D - 3; E - 1,3,4; F - 1.]

COTTON

AL, MS Skinner, R. B. 1974. The relative and seasonal abundance of spiders from the herb-shrub stratum of cotton fields and the influence of peripheral habitat on spider populations. M. S. Thesis, Auburn Univ., Alabama. 107 pp.
[A - 4; B - 3; C - 1; D - 27; E - 1,2; F - 2.]

AR Whitcomb, W. H. and K. Bell. 1964. Predaceous insects, spiders, and mites of Arkansas cotton fields. Univ. Arkansas Agric. Exp. Stn. Bull., 690:1-84.
[A - 6; B - 5; C - 1,2; D - 4+; E - 1,2,3,4,5; F - 2.]

CA Leigh, T. F. and R. E. Hunter. 1969. Predacious spiders in California cotton. California Agric., 1969:4-5.
[A - 1; B - 12; C - 1,2; D - 3; E - 1,2,3,4,5; F - 2.]

LA Mysore, J. S. and D. W. Pritchett. 1986. Survey of spiders occurring in cotton fields in Ouachita Parish, Louisiana. Proc. Louisiana Acad. Sci., 49:53-56.
[A - 1; B - 6; C - 1,2; D - 4; E - 1,3,4; F - 1.]

MS Lockley, T. C., J. W. Smith, W. P. Scott and C. R. Parencia. 1979. Population fluctuations of two groups of spiders from selected cotton fields in Panola and Pontotoc Counties, Mississippi, 1977. Southw. Entomol., 4:20-24.
[A -1; B - 4; C - 1; D - 30; E - 2; F - 2.]

TX Dean, D. A., W. L. Sterling and N. V. Horner. 1982. Spiders in eastern Texas cotton fields. J. Arachnol., 10:251-260.
[A - 3; B - 5; C - 1; D - 1+; E - 1,2,3,4; F - 1.]

TX Kagan, M. 1943. The Araneida found on cotton in central Texas. Ann. Entomol. Soc. America, 36:257-258.
[A - 2; B - ?; C - 1; D - 3; E - 4; F - 2.]

SOYBEAN

DE Culin, J. D., Jr. 1978. Spiders in soybean fields: Community structure, temporal distributions of the dominant species, and colonization of the crop. M. S. Thesis, Univ. of Delaware, Newark.
[A - 1; B -12; C - 1; D - 7; E - 3,7; F - 2.]

FL Hasse, W. L. 1971. Predaceous arthropods of Florida soybean fields. M. S. Thesis, Univ. of Florida, Gainesville.
[A - 1; B - 4; C - 1; D - 12; E - 1,3,7; F - 1.]

FL Neal, T. M. 1974. Predaceous arthropods in the Florida soybean agroecosystem. M. S. Thesis, Univ. of Florida, Gainesville.
[A - 3; B - 4; C - 1; D - 12; E - 1,2,3,4,7; F - 1.]

IA Bechinski, E. J. and L. P. Pedigo. 1981. Ecology of predaceous arthropods in Iowa soybean agroecosystems. Environ. Entomol., 10:771-778.
[A - 2; B - 4; C - 1; D - 15; E - 1,3,7; F - 2.]

IL LeSar, C. D. and J. D. Unzicker. 1978. Soybean spiders: Species composition, population densities, and vertical distribution. Illinois Nat. Hist. Surv. Biol. Notes, 107:1-14.
[A - 2; B - 4; C - 1; D - 3; E - 1,2,7; F - 2.]

KY Culin, J. D. and K. V. Yeargan. 1983. Spider fauna of alfalfa and soybean in central Kentucky. Trans. Kentucky Acad. Sci., 44:40-45.
[A - 3; B - 9; C - 1; D - 4; E - 3,7; F - 1.]

LA Goyer, R. A., D. W. Brown and J. B. Chapin. 1983. Predaceous arthropods found in soybean in Louisiana. Proc. Louisiana Acad. Sci., 46:29-33.
[A - 1; B - 4; C - 1; D - 3; E - 1,3; F - 1.]

MO Bickenstaff, C. C. and J. L. Huggans. 1962. Soybean insects and related arthropods in Missouri. Univ. Missouri Agric. Exp. Stn. Res. Bull., 803:1-51.
[A - 3; B - 4; C - 1; D - 21; E - 1; F - 2.]

NC Deitz, L. L., J. W. Van Duyn, J. R. Bradley, Jr., R. L. Rabb, W. M. Brooks and R. E. Stinner. 1976. A guide to the identification and biology of soybean arthropods in North Carolina. North Carolina Agric. Res. Serv. Tech. Bull., 238:1-264.
[A - 4; B - 4; C - 1; D - 40; E - 2,7; F - 1.]

ALFALFA

CA Yeargan, K. V. and C. D. Dondale. 1974. The spider fauna of alfalfa fields in northern California. Ann. Entomol. Soc. America, 67:681-682.
[A - 3; B - 12; C - 1,2; D - 6+; E - 1,2,3,4; F - 1.]

KY Culin, J. D. and K. V. Yeargan. 1983. Spider fauna of alfalfa and soybean in central Kentucky. Trans. Kentucky Acad. Sci., 44:40-45.
[A - 3; B - 10; C - 1; D - 4; E - 2,3; F - 1.]

NY Wheeler, A. G., Jr. 1973. Studies on the arthropod fauna of alfalfa V. spiders (Araneida). Canadian Entomol., 105:425-432.
[A - 4; B - 7; C - 1; D - 3; E - 1,3,4; F - 1.]

VA Howell, J. O. and R. L. Pienkowski. 1971. Spider populations in alfalfa, with notes on spider prey and effect of harvest. J. Econ. Entomol., 64:163-168.
[A - 2; B - 12; C - 1,2; D - 1; E - 1,2; F - 1.]